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DRAWINGS ATTACHED

1 314 901

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(54) IMPROPEMENTS IN OR RELATING TO SYNCHRONOUS ALTERNATING CURRENT MOTORS

(71) We, BROOK MOTORS LIMITED, of Empress Works, Huddersfield, in the County of York, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

It is known to make a synchronous alternating current motor with permanent magnets in its rotor. The polar axes of the permanent magnets lock with the primary field, and give rise to the magnetic or fundamental torque of the machine.

According to this invention a synchronous alternating current motor has a rotor core in which are disposed permanent magnets arranged with their respective polar axes each at a tangent to an imaginary circle drawn in a radial plane about a point on the axis of rotation of the rotor, the permanent magnets being so arranged that at least one resultant polar axis is produced by like poles of adjacent magnets being adjacent to each other, and the magnets being located in core segments of magnetic material, there being a flux leakage gap between the ends of adjacent segments each such gap being coincident with the middle of one of the magnets.

Previously, permanent magnet synchronous machines have usually had the polar axes radiating from the axis of rotation of the rotor. This of course, is the obvious design to adopt if one bears in mind that the flux of each magnet is to be attracted by the primary field forces. However, improvements can be obtained with the tangential arrangement. The arrangement also provides at least one resultant radial polar axis bisecting the angles between adjacent magnet ends.

One construction of a permanent magnet synchronous alternating current motor in accordance with the invention will now be described by way of example only with reference to the accompanying drawing which is a cross-section through the rotor of the motor. It is not necessary to illustrate or describe the stator of the machine, because this is entirely conventional.

The particular motor illustrated in the drawing is a four pole machine, but it is to be clearly understood that the invention can be used with motors having any number of pairs of poles.

The rotor core is made of segments 10, 12, 14 and 16 separated by magnet leakage flux barriers 18, 20, 22 and 24. The core is mounted on a rotor shaft 26. Slots 28 are formed in the periphery of the core, and conductors (not shown) are located in these in a squirrel cage arrangement. As is well known in the art, this form of winding provides for the starting and stabilising of the machine.

The shape of the segments is such that four spaces are formed between adjacent pairs of segments and the shaft 26, and permanent magnets 30, 32, 34 and 36 are located in these spaces. Polarisation of the permanent magnets is indicated by arrows in the drawing, and it will be observed that the principal polar axis of each magnet is tangential to an imaginary circle about the axis of rotation of the rotor, and that adjacent ends of the magnets are of like polarity. Thus it will be appreciated that the rotor has an N-pole between the adjacent ends of the magnets 36 and 30, an S-pole between the ends of the magnets 30 and 32, an N-pole between the ends of the magnets 32 and 34, and an S-pole between the ends of the magnets 34 and 36.

Thus for the purpose of the synchronous motor action, the rotor can be regarded as having resultant polar axes indicated by the chain dotted lines Q—Q and R—R.

Apart from improved operational characteristics, one of the important advantages of the invention is that the permanent magnets 30, 32, 34 and 36 can be circumscribed by

a circle of smaller diameter than would be the case with radially arranged magnets. Consequently, the rotor can be of smaller construction, or alternatively, it is possible to employ segments containing a greater mass of magnetic material.

In some instances, it is desirable to reduce the length of the periphery of each segment at the air-gap between the rotor and the stator. This can be achieved for example, by cutting away some of the material of each segment as indicated by the dotted lines 40, taking care to maintain a small flux leakage gap between the ends of adjacent segments. It should also be understood, that instead of having complete breaks 18, 20, 22 and 24 between the segments, there could in actual construction be narrow bridges of magnetic material joining the segments together. Since these bridges saturate with the concentration of the magnetic flux, they behave substantially as non-magnetic sections.

Whilst in the example described above, the number of magnets is equal to the number of poles, it should be understood that arrangements in which the number of poles differ from the number of magnets are possible, and are within the scope of the invention. Thus, for example, if the polarity of the magnets 30 and 32 shown in the drawing were reversed, there would be an N-pole between adjacent ends of magnets 30 and 32, and an S-pole between the adjacent ends of magnets 34 and 36, but no other poles would be produced and consequently the machine would be a two pole machine.

WHAT WE CLAIM IS:—

1. A synchronous alternating current motor having a rotor core in which are disposed permanent magnets arranged with their respective polar axes each at a tangent to an imaginary circle drawn in a radial plane about a point on the axis of rotation of the rotor, the permanent magnets being so arranged that at least one resultant polar axis is produced by like poles of adjacent magnets being adjacent to each other, and the magnets being located in core segments of magnetic material, there being a flux leakage gap between the ends of adjacent segments each such gap being coincident with the middle of one of the magnets.

2. A synchronous alternating current motor as claimed in Claim 1, in which each pole of each magnet is adjacent to a like pole of an adjacent magnet.

3. A synchronous alternating current motor as claimed in Claim 1, in which some of the material of each segment is cut away at the periphery of the segment to reduce the length of the periphery of each segment at the air gap between the rotor and the stator.

4. A synchronous alternating current motor as claimed in Claim 3, in which the cut away is at each end of each segment.

5. A synchronous alternating current motor as claimed in Claim 1, constructed and arranged substantially as herein described with reference to the accompanying drawing.

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1314901 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*